

METHOD, AND ARRANGEMENT IN A COMMUNICATIONS NETWORK

This application claims the benefit of U.S. provisional application No. 60/208,098, filed May 31, 2000.

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FIELD OF INVENTION

The present invention relates to a method and an arrangement in a data communications system according to the preambles of 10 the independent claims. More specifically it relates to a processing unit wirelessly connected to a printer. It further relates to printing a document by means of the printer, the printer being controlled by the processing unit.

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DESCRIPTION OF RELATED ART

Processing units, e.g. PC's requiring to print documents uses 20 typically a printer. A processing unit and a printer are generally communicating with each other through cables. But communication disruption caused by wire breakage or inadequate securing of the cable ends, added cost of providing a reliable cable and reliable associated connectors, tangling of the cables and requirements of flexibility, etc. leads to a 25 requirement of replacing the cables.

A way of communicating, using a infrared link instead of a cable is shown in the American patent US 6,055,062, which discloses an electronic printer having an attached accessory unit. The accessory unit handles e.g. optional media (e.g. 30 paper) supply units and optional media output. To communicate with the accessory unit, the printer uses a two-ways infrared communications connection to the accessory unit to which it is immediately adjacent.

However the range of the infrared link is short, so that the 35 distance between processing unit and the printer have to be less than a few meters and there must be a clear line of sight between them.

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The so-called Bluetooth interface is an example of a modern radio interface, which was originally intended as replacement for cables between units. The term Bluetooth is in this disclosure used as an example of usage of short-range radio communication. By replacing the cables, the short-range radio technology provides a universal bridge to existing data networks, a peripheral interface, and a mechanism to form small private ad hoc groupings of connected devices away from fixed network infrastructures or connected to a fixed network infrastructure via a gateway. Designed to operate in a noisy frequency environment, the Bluetooth radio uses a fast acknowledgement and frequency hopping scheme to make the link robust. Bluetooth radio modules avoid interference from other signals by hopping to a new frequency after transmitting or receiving a data packet, as shown in **Figure 1** wherein the X-axis represents the frequency f and the Y-axis represents the time t . Compared with other systems operating in the same frequency band, the Bluetooth radio typically hops faster and uses shorter radio packets. This makes Bluetooth radio more robust than other systems. Use of Forward Error Correction (FEC) limits the impact of random noise on long-distance links.

Bluetooth radio is a wireless communication technology using a frequency-hopping scheme in the unlicensed Industrial Scientific Medical (ISM) band at 2,4 GHz. A frequency hop transceiver is applied to combat interference and fading. A shaped, binary FM modulation is applied to minimise transceiver complexity. The gross data rate is 1Mb/s and Time-Division Duplex (TDD) scheme is used for full duplex transmission.

The Bluetooth protocol is a combination of circuit and packet switching. In **Figure 1**, S1 denotes one time slot, and P1 denotes a packet covering three time slots. A time slot is 0,625 ms long. Time slots can be reserved for synchronous 5 packets. Each packet is normally transmitted in a different hope frequency. A packet normally covers a single slot, but can be extended to cover up to five slots. Bluetooth can support an asynchronous data channel, up to three simultaneous synchronous voice channels, or a channel with simultaneously 10 supports asynchronous data and synchronous voice. Each voice channel supports 64 kb/s synchronous (voice) link. The asynchronous channel can support an asymmetric link of maximally 721 kb/s in either direction while permitting 57,6 kb/s in the return direction, or a 432,6 kb/s symmetric link.

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In **figure 2**, the different function blocks of a system using short-range radio transceivers such as Bluetooth are shown. A radio unit 201 is connected to a link control unit 202 providing the base band. The link control unit 202 is 20 connected to the Central Processing Unit, called CPU, 203 providing the link management. The CPU is connected to the memory 204 providing software functions and consisting of two memory units: a SRAM 205 and a FLASH 206. The CPU 203 is 25 connected to a host interface 207. A SRAM is a fast temporary memory. FLASH is a programmable ROM.

Two or more, up to eight Bluetooth units sharing the same channel form a piconet, i.e. a piconet is a collection of 30 devices connected via Bluetooth technology in an ad hoc fashion. Within a piconet a Bluetooth unit can have either of two roles: master or slave. Within each piconet there may be one and only one master, and up to seven active slaves, i.e. 35 a piconet starts with two connected devices, such as a portable PC and a cellular telephone, and may grow to eight connected devices. All Bluetooth devices are peer units and

have identical implementations. Any Bluetooth unit can become master in a piconet. A master unit is the device in a piconet whose clock and hopping sequence are used to synchronise all other devices within the piconet. A slave unit is every device in a piconet that is not a master.

The communication within a piconet is organised such that the master polls each slave according to some polling scheme.

10 Master-to-slave transmission always starts in an even-numbered time-slot while slave-to-master transmission always starts in an odd-numbered time slot. With one exception the slave is only allowed to transmit after have been polled by the master. The slave then starts its transmission in a slave-to-master time slot immediately following the packet received from the master. The master may or may not include data in the packets used to poll the slave. The only exception to the above principle is that when a slave has an established Synchronous Connection Oriented (SCO) link, the slave is always allowed to

15 transmit in the pre-allocated slave-to-master slot, even if not explicitly polled by the master in the preceding master-to slave slot. The term SCO-link will be disclosed in more details below. In a Bluetooth communications system there is no direct transmission between slaves in a piconet.

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The Bluetooth protocol stack will be described, according to the specifications of the Bluetooth system. The protocol stack which is depicted in **figure 3**, includes two Bluetooth units

30 301 and 302. In the figure the physical layer and the data link layer are shown.

Baseband **BB**

The base band describes the digital signal processing part

35 of the hardware, i.e. the Bluetooth link controller, which carries the Bluetooth protocols and other low-level link

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5 routines. The Baseband resides in the physical layer 301 and the data link layer 304. The baseband specification defines two link types: Synchronous Connection-Oriented (SCO) links and Asynchronous Connection-Less (ACL) links. SCO links support real-time voice traffic using reserved bandwidth. ACL links support best effort traffic.

Link Manager Protocol **LMP**

10 LMP handles messages used for link set-up, security and control. LMP is layered over the Baseband protocol and resides in the data link layer 304.

15 Logical Link Control and Adaptation layer Protocol, **L2CAP**

15 L2CAP is also layered over the Baseband protocol and resides in the data link layer 304. L2CAP provides connection oriented and connectionless data services to upper layer protocols with multiplexing capability, segmentation and reassemble operation, and group abstractions. The L2CAP Specification is only defined for 20 ACL links.

25 Network layer 305

25 The network layer is currently not specified in the Bluetooth standard.

30 High level protocol or application 306

30 Device information, services and the characteristics of the services can be queried using the Service Discovery Protocol SDP. Like SDP, RFCOMM is layered on top of the L2CAP. RFCOMM is the 'cable replacement' protocol, which provides transport capabilities for high-level services (e.g. OBEX protocol) that use serial line as the transport mechanism.

35 On top of the link and transport protocols, the applications still need some specific protocols to complete the protocol

stack. In the Bluetooth architecture, the application-specific protocols are added on top of RFCOMM or directly on the L2CAP. L2CAP can only be accessed via a protocol which is supported by a Bluetooth profile such as RFCOMM..

5 The enumerated application-specific protocols offer the basic functionality in the Bluetooth environment and they provide only the cable-replacement capabilities. Features such as broadcasting, point-to-multipoint topologies, and scatternet 10 possibilities are not really utilised by these current high-level protocols and usage models. Thus, there are numerous 15 possibilities for developers to create more applications, the nature of which can be totally different from the existing ones.

15 The object of the present invention is to achieve a wireless 20 communication between a processing unit and a printer using a safe transmission and an increased transmission range compared to the infrared transmission used in the above 25 mentioned US-patent.

SUMMARY OF THE INVENTION

25 The object of the invention is to unravel the above mentioned drawbacks and achieve a way of printing a document in a data communications system using a protocol profiled for printing in the Bluetooth protocol architecture.

30 This is achieved according to the method and arrangement set forth in the characterising parts of the independent claims.

Preferred embodiments are set forth in the independent claims.

An advantage of the method and arrangement according to the present invention is that it is possible to communicate wirelessly with a printer at a wide range, up to 10 meters and extendable up to 100 meters.

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Another advantage is that it offers a safe transferring of data.

10 Yet another advantage is that the present invention makes it possible to wirelessly select a printer among available printers.

BRIEF DESCRIPTION OF THE DRAWINGS

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Figure 1 is a diagram showing the relationship between timeslots and frequency hops in a system using Bluetooth.

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Figure 2 is a diagram illustrating the different function blocks of a Bluetooth system.

Figure 3 is a diagram showing the Bluetooth protocol stack.

Figure 4 is a schematic block diagram showing a communications system according to the present invention.

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Figure 5 is a schematic block diagram showing an entity according to the present invention.

Figure 6 is a schematic block diagram showing a printer entity according to the present invention.

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Figure 7 shows a flowchart of the method according to the invention.

Figure 8 is a bloc diagram depicting a protocol overview over the Bluetooth protocols according to the invention.

Figure 9 shows a signalling sequence over a typical SDP transaction.

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Figure 10 shows a signalling sequence over typical WPP transactions.

Figure 11 shows a signalling sequence over typical WPP transactions.

Figure 12 shows a signalling sequence over typical WPP transactions.

5 Figure 13 shows a signalling sequence over typical WPP transactions.

Figure 14 shows a signalling sequence over typical WPP transmission.

Figure 15 shows a signalling sequence over typical WPP

DESCRIPTION OF PREFERRED EMBODIMENTS

15 Figures 1-3 are related to prior art and described above under "Description of related art".

The wording "client" is in this disclosure defined as the entity sending a request, and the wording "server", is in this disclosure defined as the entity receiving a request.

20 **Figure 4** shows a possible scenario of the present invention.
A Bluetooth data communications system 401 includes two nodes
whereof one is a processing unit, which in this example is a
PC 402 and the other is a printer 403. A wireless printer
25 protocol according to the invention is implemented in the
Bluetooth protocol stack which is included in a entity, e.g.
a PC-card 404, connected to or implemented in the PC 402, and
in a printer entity, e.g. a printer adapter 405, connected to
or implemented in the printer 403. According to the Bluetooth
30 standard the distance between the processing unit and the
printer is up to 10 meters and extendable up to 100 meters. The
printer adapter 405 might be connected to the printer port on
the printer. The PC 402 and the printer 403 are connected to
35 each other via a Bluetooth air interface 406. Both entities
404 and 405 comprise a respective computer, each computer

comprising an internal memory for storing computer program not visible in Figure 4.

5 The entity 404 connected to or implemented in the processing unit 402, will now be described more in detail. The entity, now referred to as 501 is shown in **Figure 5**. The entity 501 includes a Bluetooth protocol stack in which protocol stack a wireless printer protocol is implemented. The printer protocol
10 comprises a printer client which communicates with a printer server by means of the wireless printer protocol, the Bluetooth protocol stack and air interface,. The printer server is included in a printer but is not visible in Figure 5.

15 The entity 501 includes an establishing device 502 arranged for establishing a bi-directional wireless ACL connection between the processing unit and the printer by means of the Bluetooth protocol.

20 The entity 501 comprises further a sending device 503 arranged for sending a connection request message to the printer server and a negotiating device 504 arranged for negotiating configuration parameters with the printer server. The
25 negotiating device 504 comprises a sending device 505 arranged for sending, to the printer server, a configuration request message including no new options if the printer client uses default values. The negotiating device 504 comprises also a sending device 506 arranged for sending, to the printer server, a configuration request message including a suggestion of configuration options. The negotiating device 504 comprises further a sending device 507 arranged for sending, to the printer server, a further configuration request message including a suggestion of configuration options which differs
30 from earlier suggestions of configuration options. This latter sending device 507 is to be used if the printer client

receives a response message from the printer server that the configuration request was not acceptable due to e.g. unacceptable parameters, unknown option etc.

5 The entity 501 comprises a sending device 508 arranged for sending a set attribute request message to the printer server, the message comprising e.g. a coding table concerning a negotiated coding type and is to be loaded by the printer server.

10 The entity 501 comprises a sending device 509 arranged for sending keep alive messages frequently to the printer server. A keep alive timer 510 is implemented in the entity 501 and comprises a starting device 511 arranged for starting and restarting the keep alive timer 510 each time a valid message is sent to the printer server and each time a valid message is received from the printer server. The keep alive timer 510 further comprises a closing device 512 arranged for closing the connection between to the printer server, when the keep alive timer 510 expires.

15 20 For starting one or more printjobs the entity 501 comprises a starting device 513 arranged which starting device 513 comprises a sending device 514 arranged for sending a request message to the printer server comprising a request to start a printjob.

25 The print data that is to be printed by the printer is sent by means of a sending device 515 arranged for sending the print data to the printer server. Said device 515 includes a sending device 516 arranged for sending a number of request messages to the printer server, the messages comprising print data.

30 35 A printing process might be broken, e.g. because the printer runs out of paper or the ACL connection is broken, etc. This is reported by the printer server in a message received by the printer client. The entity 501 comprises a device 527 arranged for interpret the message and give a note to the user of the

processing unit, e.g. by presenting the note on the screen of the PC.

5 E.g. a refill of paper or a new creation of a disconnected ACL connection might make, but the entity 501 comprises a continuing device 517 arranged for continuing the printing process by continuing to send print data request messages to the printer server, starting with the print data subsequent to a last received print data acknowledgement message.

10 The entity 501 comprises a stopping device 518 arranged for stopping the keep alive timer 510 when an ACL connection is disconnected during a printing process.

15 The entity 501 further comprises a requesting device 519 arranged for requesting a reconnection of a session defined by the session identifier in a message sent to the printer server to be used when a new ACL connection is created to the printer, after a break.

20 The entity 501 comprises a stopping device 520 arranged for stopping the print job said stopping device 520 comprises a sending device 521 arranged for sending a message to the printer server, the message comprising a request to stop the 25 printjob. The stopping device 520 will be used when all data to be printed in a printjob is sent to the printer.

30 The entity 501 further comprises a closing device 522 arranged for closing the connection between the processing unit and the printer, the closing device comprising a sending device 523 arranged for sending a message to the printer server, the message comprising a request to disconnect a session identified by a session identity.

35 The entity 501 comprises a stopping device 524 arranged for stopping the sending of keep alive messages after closing a connection between the printer client and the printer server.

The entity also comprises a receiver 525 for receiving messages sent from a printer and a transmitter 526 for sending messages to the printer.

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The printer entity 405 connected to or implemented in the printer 403 shown in Figure 4, will now be described more in detail. The printer entity, now referred to as 601 is shown in 10 **Figure 6**. The printer entity 601, including a Bluetooth protocol stack in which a wireless printer protocol is implemented, said protocol comprising a printer server which communicates, by means of the wireless printer protocol, the Bluetooth protocol stack and air interface, with a printer 15 client, e.g. the printer client in the entity 501 described above. The printer client is included in a processing unit 402 and is not visible in Figure 6.

20 The printer entity 601 comprises a receiver 602 for receiving messages sent from a processing unit and a transmitter 603 for sending messages to the processing unit.

25 The printer entity 601 further comprises a responding device 604 arranged for responding upon a connection request whether the connection is successful or not, in a response message sent to the printer client.

30 The printer entity 601 comprises a negotiating device 605 arranged for negotiating configuration parameters with the printer client within the processing unit.

The negotiating device 605 comprises a responding device 606 arranged for responding upon a configuration request whether the configuration options in the configuration request are supported by the printer server or not.

The negotiating device 605 comprises a loading device 607 arranged for loading a coding table or other optional attributes sent from the printer client.

5 The negotiating device 605 further comprises a sending device 608 arranged for sending a response, whether the loading of the coding table was successful or not, to the printer client.

10 The printer entity 601 comprises a sending device 609 arranged for sending keep alive messages frequently to the printer client.

15 A keep alive timer 610 is implemented in the printer server within the printer entity 601. The printer entity 601 comprises a starting and restarting device 611 arranged for starting the keep alive timer each time a valid message is received from the printer client and each time a valid message is sent to the printer client.

20 The printer entity 601 comprises a starting device 612 arranged for starting a print job. The starting device 612 comprises a confirming device 613 arranged for confirming a start printjob request message sent to the printer client

25 The printer entity 601 comprises a receiving device 614 arranged for receiving print data from the printer client. The receiving device 614 including a sending device 615 arranged for sending an acknowledgement message to the printer client after receiving a previous decided number of print data request messages.

30 The printer entity 601 comprises an indicating device 616 arranged for indicating, in a message sent to the printer client, that the printer has reported an exemption condition, e.g. that the printer is out of paper, if the printer runs out of paper.

35 The printer entity 601 further comprises an indicating device 617 arranged for indicating, in a message sent to the printer

client, when the printer clears the exemption, e.g. that the printer is refilled, when the printer is refilled.

5 The printer entity 601 comprises a stopping device 618 arranged for stopping the keep alive timer when an ACL connection to the processing unit is disconnected during a printing process.

10 The printer entity 601 comprises a sending device 619 arranged for sending a response message to the printer client, according to whether a reconnection request is granted or not.

15 The printer entity 601 comprises a stopping device 620 arranged for stopping the print job.

20 15 The stopping device 620 including a sending device 621 arranged for sending a response message, after the printer server has received a request to stop the printjob, the message comprising a confirmation that this is apprehended and is sent to the printer client.

25 The printer entity 601 comprises a sending device 622 arranged for sending a response message to the printer client, according to whether a disconnection request is granted or not.

30 25 The printer entity 601 further comprises a stopping device 623 for stopping the sending of keep alive messages after the connection to the printer client is closed.

35 **Figure 7** shows a flowchart of a possible scenario of the printing process according to the present invention.

The method includes the following steps:

701. A bi-directional wireless Asynchronous Connection-Less (ACL) connection is established between the processing unit 402 and the printer 403 by means of the printer protocol calling the L2CAP requesting the connection and the L2CAP creating the connection.
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702. A connection is established between the printer client and the printer server for one or more printjobs.
703. The processing unit 402 and the printer 403 negotiate configuration parameters for said connection.
- 10 704. Keep alive messages are sent frequently during the session from the processing unit 402 to the printer 403 and from the printer 403 to the processing unit 402.
705. The processing unit 402 starts the printjob and
706. sends the printer data to the printer 403.
- 15 707. The print job is stopped and
708. the connection is closed between the processing unit 402 and the printer 403.

The method is implemented by means of a computer program product comprising the software code portions for performing the steps of the method. The computer program product is run on a computer stored in a digital computer within the process unit 402 and within the printer 403, e.g. in the printer adapter 405.

25 The computer program is loaded directly or from a computer usable medium, such as floppy-disc, CD, Internet etc.

Figure 8 is a bloc diagram depicting a protocol overview over the Bluetooth protocols including the wireless printer protocol **WPP** according to the invention. The left side represents the PC 801 and the right side represents the Printer 802. The Host Control Interface **HCI** is marked as a horizontal line. The **HCI** provides a command interface to the baseband controller, link manager, and access to hardware status and control registers.

SDP, L2CAP and LMP are described above, under Related Art. WPP will be described more in detail below.

The interface between two entities on the same layer, a so-called horizontal interface, is defined by its protocol 803, 5 804, 805 and 812, e.g. L2CAP on PC communicates with L2CAP on printer using the L2CAP protocol.

The actual flow of data (Protocol Data Units, PDU:s) is done between entities in different layers 806, 807, 808, 809, 810 10 and 811, a so-called vertical interface.

On the PC side the protocols are implemented by following applications:

- Client L2CA Application implements L2CAP
- Client Printer Application implements WPP
- Client Discovery Application implements SDP

On the printer side the protocols are implemented by following applications:

- Server L2CA Application implements L2CAP.
- Server Printer Application implements WPP.
- Server Discovery Application implements SDP.

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The printing method according to the invention will now be described more in detail.

A processing unit requires to print a document, i.e. to 30 perform a printjob, by means of a printer.

The processing unit wishes to know which printers that are available, and select one of them, therefore the printing process starts with the Device Discovery procedure, which is a procedure known from the art. Figure 9 shows a sequence 35 diagram of a typical SDP transaction between the Client

Discovery Application 901 and the Server Discovery Application 902. It is assumed that inquire has been performed. As a result of inquire the class of device is retrieved. Class of device indicates the type of device and which type of services the device supports. It is also assumed that a point to point connection with the server has been established, using L2CAP. The PrinterServiceClassId is represented as a Universally Unique Identifier (UUID) and is known by client discovery application.

10 A message, e.g. a denoted *SDP_ServiceSearchReq* message 903 is sent, from Client to Server, to ask which services, in this case printers that are available. The server returns service records handles associated with the respective available printers, e.g. in a denoted *SDP_ServiceSearchRsp* message 904.

15 The printer service record database serves as a repository of discovery-related information. All of the information about a service that is maintained by an SDP server is contained in a single service record. The service record consists entirely of 20 a list of attributes. A service record handle uniquely identifies each service record within the SDP server, according to Service Discovery Protocol, Bluetooth Specification version 1.0 B concerning SDP and Appendix VIII, Bluetooth Assigned Numbers, Bluetooth Specification version 25 1.0 B concerning assigned numbers for predefined attributes and their identity.

The Client selects one of the available printers and requests for its attributes, e.g. the address of the printer, a in a 30 message, e.g. a denoted *SDP_ServiceAttributeReq* message 905 using the service record handle. The attributes are returned in one or more messages, e.g. denoted *SDP_ServiceAttributeRsp* messages 906.

The Client stores the received attributes and terminate the 35 L2CAP connection

A bi-directional wireless asynchronous connection-less (ACL) connection is established (701) between the processing unit and the printer. This is achieved by means of the printer protocol in the processing unit calling the L2CAP in the 5 within the same unit, requesting the connection to the printer. The printer is connected e.g. by means of the printer address being one of the attributes received. The L2CAP creates the connection and notifies the created connection the printer protocol.

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Figure 10 shows sequence diagrams of a typical WPP transactions concerning the connection operations between the WPP Client 1001 and the WPP Server 1002, according to the 15 invention

A creation of a session between a client printer application (source) and a server printer application (destination) is to be requested, i.e. for establishing a connection for one or 20 more printjobs. This is performed by sending a message, e.g. a denoted *WPP_Connection_Req* message 1003, from the WPP client 1001 to the WPP server 1002. This is shown in **Figure 10**. A status indication to the client printer application whether the connection was successful or not and making the session 25 valid if successful is required. This is be performed in a message by the WPP server 1002, e.g. in a denoted *WPP_Connection_Rsp* message 1004, also shown in **Figure 10**. This message also includes a session identity.

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The next step of the printing process is the WPP negotiation procedure according to the invention. **Figure 11 a-c and 12** shows sequence diagrams of a typical WPP transactions concerning the negotiation operations between the WPP Client 35 1001 and the WPP Server 1002, according to the invention.

After creating the session a configuration of the WPP server 1002 is required. Examples of configuration options are e.g. the number of print data request messages to be received by the printer before return a confirmation message, coding type 5 and table size.

Figure 11a, b and c shows three different sub-scenarios of a successful negotiation of a coding type for data compression. A message, e.g. a denoted *WPP_Configuration_Req* message, is sent from the WPP client 1001 to WPP server 1002 to establish 10 an initial logical link transmission contract between the WPP client 1001 and WPP server 1002 and to negotiate configuration parameters, e.g. the coding type. In this example the WPP server 1002 supports the coding types hamming, table size = 80 (default) and huffman table size = 80. The three respective 15 sub-scenarios may be a continuation of the connection scenario in Figure 10.

In the first sub-scenario, shown in Figure 11a, the WPP client 1001 uses default values, i.e. hamming, table size = 80 and 20 accordingly the *WPP_Configuration_Req* message 1101 sent, from the WPP client 1001 to the WPP server 1002, includes no new options. Since that is a coding type that the WPP server 1002 supports, it responses success in a message, e.g. a denoted *WPP_Configuration_Rsp* message 1102.

Figure 11b shows the second sub-scenario in which the WPP client 1001 requests the WPP server 1002, in message, e.g. a denoted *WPP_Configuration_Req* message, if hamming, table size = 100 can be used 1103. This is not a coding type that the WPP 30 server 1002 supports and accordingly it responses in a message, e.g. a denoted *WPP_Configuration_Rsp* message 1104, failure and suggests that hamming, table size = 80 can be used. The WPP client 1001 supports also hamming, table size = 80 and responses this to the WPP server 1002 in a message, 35 e.g. a denoted *WPP_Configuration_Req* message 1105. The WPP

server responses success in a message, e.g. a denoted *WPP_Configuration_Rsp* message 1106.

In the third scenario, shown in **Figure 11 c**, the WPP client

5 1001 suggests an coding type which is unknown for the printer, i.e. a coding type not supported by the printer, and a size = 100, in a message, e.g. a denoted *WPP_Configuration_Req* message, sent 1107 to the WPP server 1002. Since this coding type is unknown for the WPP server 1002, it responses in a
10 message, e.g. a denoted *WPP_Configuration_Rsp* message 1108 failure and that the coding type is unknown. The WPP client 1001 then tries another coding type that it supports, in this example huffman, size = 80, in a subsequent message, e.g. a denoted *WPP_Configuration_Req* message 1109 sent to the WPP
15 server 1002. The WPP server 1002 supports huffman, size = 80 and accordingly it responses success and confirms huffman, size = 80 in a message, e.g. a denoted *WPP_Configuration_Rsp* message that is sent 1110 to the WPP client 1001.

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After the configuration negotiation of coding type according to e.g. the scenarios depicted in Figures 11a-c, the WPP client 1001 requests to set an attribute which is illustrated in **Figure 12**. The WPP client 1001 sends a coding table
25 concerning the negotiated coding type in a message, e.g. a denoted *WPP_Set_Attribute_Req* message sent 1201 to the WPP server 1002. The WPP server loads the coding table to be used and confirms whether it was successful or failure in a message, e.g. a denoted *WPP_Set_Attribute_Rsp* message 1202
30 sent to the WPP client 1001.

The next step of the printing process is the WPP printing procedure. **Figure 13a-d, 14 and 15** shows sequence diagrams of

a typical WPP transactions concerning the printing operations, between the WPP client 1001 and the WPP server 1002, according to the invention.

5 **Figures 13a-d** shows a first sub-scenario of a successful printing of one print job. **Figure 13a** shows the procedure for sending keep alive messages.

When the connection has been established and negotiation has been performed, keep alive messages are to be sent, by the WPP 10 client 1001, 1303 and WPP server 1002, 1304, frequently, e.g. once each 5 second, as an indication that the source is up and running. Such a message is denoted *WPP_Keep_Alive* message. If a break occurs when printing, the printer will find out that, since it does not receive any more keep alive messages. 15 The printer then terminates the printjob and can let other users in. A break can also occur on the printer side. There is also occasions when the printer or processing unit are hard loaded, sending keep alive messages just to tell the receiver that it still alive but it goes slowly at the moment. When a 20 connection has been disconnected by WPP client ,WPP client 1001 and WPP server 1002 shall stop sending denoted *WPP_Keep_Alive* messages.

A WPP Keep Alive Timer is restarted each time a valid message is received from the remote endpoint. The timer is implemented 25 on both client and server side. If the Keep Alive timer expires the remote endpoint is considered faulty and the connection is closed and higher level applications is notified. The Keep Alive Timer shall be stopped when a link is disconnected and restarted when a new link is established with 30 the remote endpoint. If a new link is established within a reasonable time, e.g. 10 seconds, the printjob continues where broken. Each WPP message will trigger a restart of a WPP timer.

In **Figure 13b** a start of a printjob and sending of data to be printed is shown. The WPP client 1001 requests the WPP server 1002 to start a printjob in a denoted *WPP_Start_Print_Req* message 1305 s, which in turn confirmed by the WPP server 5 (1002) in a denoted *WPP_Start_Print_Cfm* message 1306. The WPP client then requests the WPP server 1002 to print data included in a number of denoted *WPP_Print_Data_Req* messages 1307, 1308. A confirmation is to be sent after the WPP server 1002 has received a number N *WPP_Print_Data_Req* messages 1307, 10 1308. The value of N is negotiated during configuration e.g. N = 4. The acknowledgement is e.g. sent in a denoted *WPP_Print_Data_Ack* message 1309. This procedure goes on until all data to be printed is received by the printer server. I.e. until the last *WPP_Print_Data_Req* message 1310 is received.

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When all data to be printed is sent to the printer server the client requests the printer server to stop the printjob. This is shown in **Figure 13c** wherein the WPP client 1001 sends a denoted *WPP_End_Print_Req* message 1311 to the WPP server 1002.

20 That this is apprehended by the printer server is reported e.g. in a denoted *WPP_End_Print_Rsp* message 1312 sent to the WPP client 1001.

25 After performing one or more printjobs or if a break of the printjob is requested, the client requests a disconnection of a session defined by the session identifier. Depicted in **Figure 13d**, this request is performed by e.g. sending a denoted *WPP_Disconnect_Req* message 1313 from the WPP client 1001 to the WPP server 1002 and a response, whether the 30 disconnection is granted or not, is sent in the opposite direction in a denoted *WPP_Disconnect_Rsp* message 1314.

When the session is disconnected the WPP client 1001 and the WPP server 1002 stops sending *WPP_Keep_Alive* messages.

Figures 14 shows a second sub-scenario of a successful printing of one printjob when the printer is out of paper.

5 Negotiation has been performed, a connection is established and keep alive messages are sent as described above though not visible in Figure 14. The WPP client 1001 has requested the WPP server 1002 to start the printjob in a message, e.g. a denoted *WPP_Start_Print_Req* message 1401, which is responded

10 success to in a message, e.g. a denoted *WPP_Start_Print_Rsp* message 1402. When the WPP client 1001 has requested the WPP server 1002 to print data included in a number of messages, e.g. denoted *WPP_Print_Data_Req* messages 1403, 1404, being acknowledged by the WPP server 1002 in a message, e.g. a denoted *WPP_Print_Data_Ack* message 1405, the printer is out of

15 paper. The printer server then has to report this to the client. This can be performed by the WPP server 1002 sending a message, e.g. a denoted *WPP_Status_Ind* message 1406, indicating that the printer is out of paper to the WPP client

20 1001. The message is interpreted by the wireless printer protocol and reported to the user of the processing unit, e.g. by presenting a note on the PC screen. The message is obtained by a user of the processing unit including the client, who refills the printer. The printer server then reports that the

25 printer is refilled to the WPP client 1001 by sending a message, e.g. a denoted *WPP_Status_Ind* message 1407. The last received denoted *WPP_Print_Data_Ack* message 1405 defines where to continue the printing by sending messages, e.g. denoted *WPP_Print_Data_Req* messages 1408, 1409 from the WPP client

30 1001 to the WPP server 1002. The printer will throw data if already printed or if a part of it has been printed. The printing process then continues as described above.

Figures 15 shows a third sub-scenario of a successful printing of one printjob when the ACL connection is disconnected. Negotiation has been performed, a connection is established and keep alive messages are sent as described above though not visible in Figure 15. The WPP client 1001 has requested the WPP server 1002 to start the printjob in a message, e.g. a denoted *WPP_Start_Print_Req* message 1501, which is responded success to in a message, e.g. a denoted *WPP_Start_Print_Rsp* message 1502. When the WPP client 1001 has requested the WPP server 1002 to print data included in a number of messages, e.g. *WPP_Print_Data_Req* messages 1503, 1504, the ACL connection is disconnected, indicated by HCI. The Keep Alive Timer is stopped by the WPP client 1001.

- 15 A reconnection of the session is required because it is possible for another client to start a printjob during ACL-disconnected. A session identity is used to identify the different WPP entities. If another job is ongoing the server will not accept the reconnection. The time the server will 20 wait for the reconnection has to be handled by a reconnection timer. If the timer times out the ongoing job will be flushed. After creating a new ACL-connection a reconnection of the session is requested. This can be performed by the WPP client 1001 by sending a message, e.g. a denoted *WPP_Reconnect_Req* 25 message 1506 requesting a reconnection of the session defined by the session identifier. A response according to whether the reconnection is granted or not is sent in a message, e.g. a denoted *WPP_Reconnect_Rsp* message 1507. In this example it is granted. The WPP Keep Alive timer is started again. The last 30 received denoted *WPP_Print_Data_Ack* message 1505 defines where to continue the printing by sending messages, e.g. a *WPP_Print_Data_Req* messages 1507, 1508 from the WPP client 1001 to the WPP server 1002. The printer server will throw data if already printed or if the packet is detected to be a

retransmission. The printing process then continues as described above.

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The present invention is not limited to the above-described preferred embodiments. Various alternatives, modifications and equivalents may be used. Therefore, the above embodiments 10 should not be taken as limiting the scope of invention, which is defined by the appendant claims.

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